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(54) Shield Flat Cable

(57) The individual conductors (12) of a flat cable are shielded by an integral conductive polymer layer (18) connected to a bare conductor (16). The conductive polymer layer is preferably PVC with C block or metallic particles or fibres dispersed therein. The insulation (14) on the conductors (12) is varnish or thin PVC and the outer insulation (20) is also PVC. The conductive polymer layer adds to the mechanical strength of the cable and the whole structure may be made by extrusion or lamination.

FIG. 1

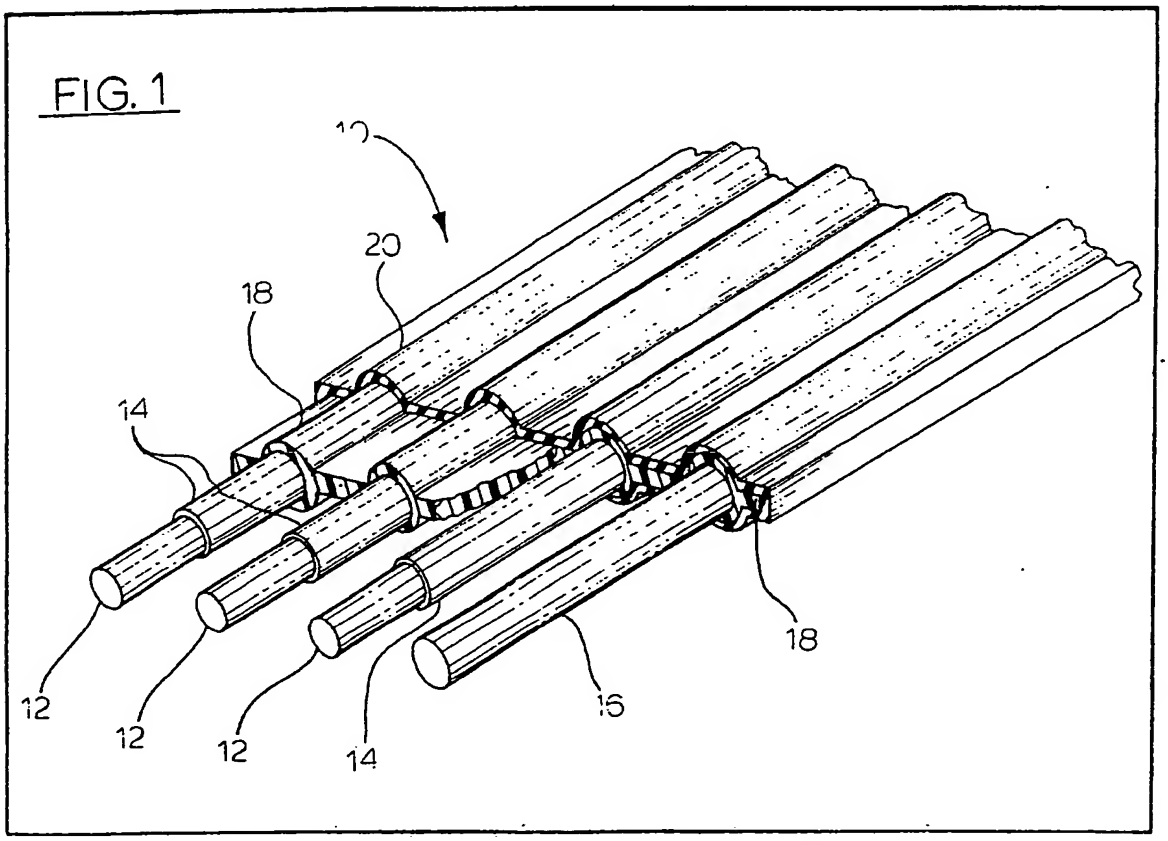

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FIG. 1

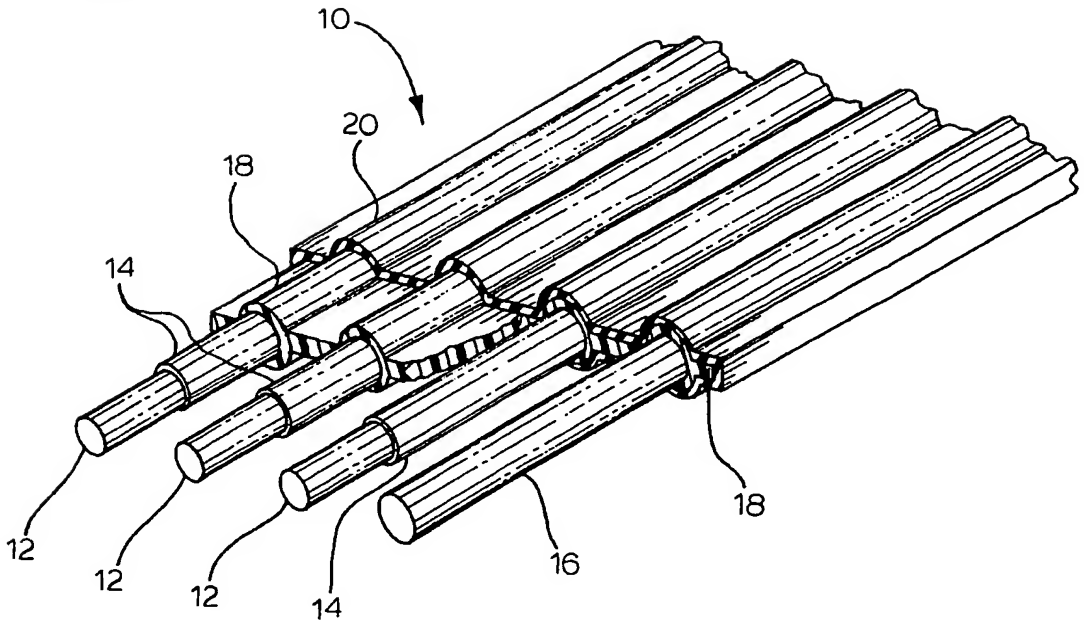
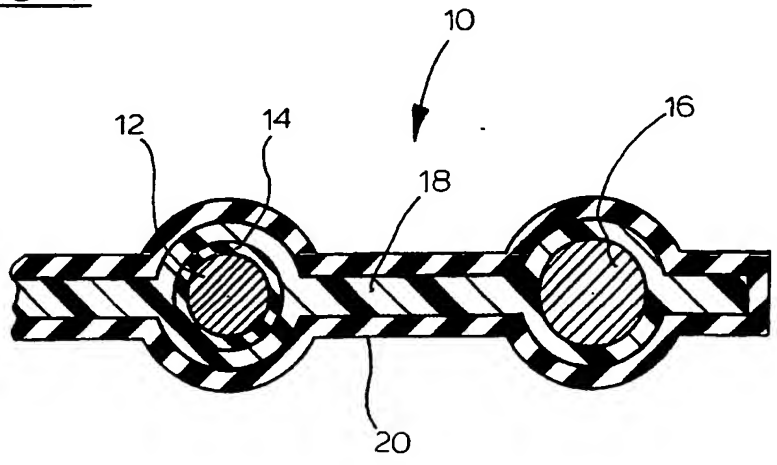


FIG. 2



SPECIFICATION

Multi-Conductor Assembly for Electrical Signals

The present invention relates to a multi-conductor assembly for electrical signals.

Planar multi-conductor assemblies for electrical signals have been used in a wide variety of applications especially where a plurality of signals have to be transmitted through cables in relatively small spaces. The conductors of an assembly may be linear and parallel to one another. The cross-section of each individual conductor may be round or flat. In other words, the scope of the art involves not only ordinary ribbon cable of the round conductor type, but, also includes ribbon cable of the flat conductor type as well as what is commonly referred to as a flat, flexible circuitry. These types of structures are referred to herein as generally planar multi-conductor assemblies or flat cable assemblies.

In conventional generally planar multi-conductor assemblies, alternate ground-signal-ground conductors are positioned side by side in one plane to establish the required transmission parameters. These parameters are: (1) characteristic impedance; (2) velocity of propagation; (3) attenuation; and (4) adequate control of line-to-line interference (crosstalk). The first three parameters are functions of the material and geometry of the assembly while the fourth parameter is generated by transmission of adjacent electrical signals.

Flat cable assemblies of the conventional type are being used today for the purposes of transmitting signals with rise times of only a few nanoseconds with satisfactory results. However, with advancements in the state of the art of sophisticated electronics, conventional flat cable assemblies are being found to be inadequate. For example, the crosstalk from one signal line to another is often of a sufficient magnitude to inadvertently trigger or actuate adjacent circuits, as in the case of dry circuit applications such as a computer.

It is desirable to confine the field of propagation within the boundaries of a uniform or homogeneous dielectric material. This results in only one propagation velocity within the assembly. When the propagation field extends beyond the assembly into the surrounding air, several undesirable phenomenon occur at high transmission line frequencies or fast rise time pulses. These phenomenon are: (1) distortion of the transmitted signal itself; (2) excessive ringing above the fast crosstalk level at the near end of the adjacent quiet line; and (3) differential crosstalk at the far end of the inter-connection.

In a single discrete wire, shielding is accomplished by using a coaxial structure, i.e., a central transmission conductor which is concentric with an intermediate insulation which is surrounded by a concentric metallic shield. Flat cable assemblies have been made by laminating a plurality of single coaxial cables between a suitable outer insulation jacket. The shielding performance is very good because each transmission line is completely surrounded by the shielding means. However, even though the shielding properties are effective, the cost of manufacture and termination are excessive.

The concept of using a flexible, metallic all-around shield over a flat cable was an early effort in eliminating the fringing field effect. The field of propagation for each signal existing between an adjacent ground conductor and the shield was confined to a homogeneous dielectric medium. In order to establish a flexible all-around shield over a flat cable assembly, it is known to provide a tight fitting, braided metallic shield around the flat cable. The wire braided cable is then covered with a yarn braided jacket. The resulting assembly thus requires both a shield and a covering. This increases the physical dimensions of the assembly and the cost of manufacture.

In order to lessen the expense of manufacturing a shielded multi-conductor assembly it is known to provide a plurality of spaced-apart insulation-clad conductors, some sort of shielding means for draining an electrical interference field from the assembly, and an outer insulation jacket defining the outer portion of the assembly. An example of such a configuration is disclosed in U.S. Patent No. 3,703,604 granted November 21, 1972, and entitled "Flat Conductor Transmission Cable".

U.S. Patent No. 3,703,604 shows a flat shielded cable assembly which comprises a plurality of parallel, spaced-apart signal conductors in a first plane and a shield member in the form of a conductive ground plane facing the signal conductors and being positioned in the second plane. The shield member comprising the conductive ground plane is made from metal foil or the like.

The disadvantages of the structure disclosed in U.S. Patent No. 3,703,604 include the inability of the shielding means to decrease the crosstalk to an acceptable level. This is because the shield member does not surround the conductors, but, instead is in a plane separate from that of the conductors. In addition, it must be realized that an assembly of the type described herein is usually manufactured in a laminating process. To use a material, such as a metal foil, which is not subject to heat lamination, detracts from the mechanical strength of the assembly as well as adding to the expense and complexity of the manufacturing process. In addition, the prior art structures as discussed above would not lend themselves to manufacture by an extrusion process.

The present invention provides a generally planar multi-conductor assembly including a plurality of spaced-apart, insulation-clad conductors, an outer insulation jacket defining the outer portion of said assembly, and shielding means for draining an electrical interference field from said assembly comprising at least one bare

conductor spaced from said insulation-clad conductor and an integral, homogeneous conductive polymer substrate within the outer insulation jacket and surrounding all of said conductors, whereby said electrical interference field is transmitted through said conductive polymer substrate and drained out of the assembly through said bare conductor.

In accordance with the present invention, the shielding means has a superior mechanical strength and is easier and less expensive to manufacture than has been heretofore known.

A specific embodiment of the present invention will now be described by way of example, and not by way of limitation, with reference to the accompanying drawings in which:—

Fig. 1 is a perspective view partially in section of a portion of a planar multi-conductor assembly of the present invention showing the different layers of the assembly; and

Fig. 2 is an enlarged sectional view of a portion of the assembly shown in Fig. 1.

With reference now to the accompanying drawings, the generally planar, multi-conductor assembly 10 is one that is commonly referred to as round conductor ribbon cable. However, it shall be appreciated that the present invention is equally applicable to assemblies having flat conductor ribbon cable or flat flexible circuitry.

The assembly 10 is seen to generally include a plurality of linear, parallel, spaced-apart conductors 12 having a thin coating of insulation 14 formed thereon. The assembly 10 also includes at least one bare conductor 16 which is spaced-apart and linear with respect to the other conductors 12. It is to be noted that more than one bare conductor 16 can be provided depending on the application.

The conductor 12 and its insulation 14 along with the bare conductor 16 are embedded in a conductive polymer substrate 18. The polymer substrate 18 is integral, homogeneous and surrounds all of the conductors 12 and 16. The polymer can be made of any plastics such as polyvinyl chloride which is impregnated with a conductive material such as carbon black or metallic particles or fibers. The polymer substrate 18 performs the following functions:

1. It adds to the body, and, therefore, the mechanical strength of the assembly because it is laminated or extruded integrally therewith.

2. Because the polymer is capable of being laminated or extruded, the manufacturing operation becomes less expensive and easier.

3. The conductive polymer substrate 18 provides a complete electrically conductive enclosure for the primary signal wire dielectric medium which intercepts the electrical interference from the signal wires 14 and transmits them to the bare conductor 16.

The assembly 10 is then provided with a usual outside insulation jacket 20. The outside insulation jacket 20 can be made of polyvinyl chloride or any other suitable insulation material that is capable of being laminated or extruded.

The insulation 14 described above is relatively thin and can be either a varnish coated type of insulation or a very thin polymeric insulation such as polyvinyl chloride. By varying the thickness of the insulation 14, one can vary the impedance of the assembly 10. That is, the thicker the insulation 14, the greater the impedance.

Claims:

1. A generally planar, multi-conductor assembly including a plurality of spaced-apart, insulation-clad conductors, an outer insulation jacket defining the outer portion of said assembly, and shielding means for draining an electrical interference field from said assembly comprising at least one bare conductor spaced from said insulation-clad conductors and an integral, homogeneous, conductive polymer substrate within the outer insulation jacket and surrounding all of said conductors, whereby said electrical interference field is transmitted through said conductive polymer substrate and drained out of the assembly through said bare conductor.

2. The assembly of claim 1 wherein said conductors are substantially linear and parallel to one another.

3. The assembly of claim 1 or 2 wherein said conductors are substantially circular in cross-section.

4. The assembly of claim 1, 2 or 3 wherein said conductive polymer substrate includes an insulative plastics material impregnated with a conductive material.

5. The assembly of claim 4 wherein said conductive material includes carbon black.

6. The assembly of any preceding claim wherein the insulation surrounding said insulation-clad conductors includes a thin varnish coating.

7. A generally planar, multi-conductor assembly substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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